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(71) 出願人 591194034

レックスマーク・インターナショナル・インコーポレーテッド

LEXMARK INTERNATIONAL, INC

アメリカ合衆国 40511 ケンタッキー、
レキシントン、ノース・ウェスト、ニュー・サークル・ロード 740

(72) 発明者 サンドラ・ヘルトン・マッケイン

アメリカ合衆国 40515 ケンタッキー、
レキシントン、ハートランド・パークサイド・ドライブ 2328

(74) 代理人 弁理士 大橋 邦彦

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(54) 【発明の名称】 インク組成物及びそれを用いた印刷方法

(57) 【要約】

【課題】 インク滴の誤った方向への噴射とノズル故障が低減され、高解像度、高速度において高印刷品質あを与えるインク組成物とその印刷方法を提供する。

【解決手段】 少なくとも一つの着色剤と；湿潤剤と；置換又は非置換のラクタム、アミド、又はこれらの混合物を含む補助溶媒と；を含む水性ベースのインク組成物。

【特許請求の範囲】

【請求項1】 少なくとも一つの着色剤と；湿潤剤と；置換又は非置換のラクタム、アミド、又はこれらの混合物を含む第1の補助溶媒と；を含むインク組成物。

【請求項2】 前記着色剤のための第2の補助溶媒を含む、請求項1に記載のインク組成物。

【請求項3】 浸透剤を更に含む、請求項1に記載のインク組成物。

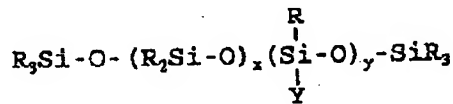
【請求項4】 前記浸透剤が、アルキル基を形成する4～10個の炭素原子を有する1，2-アルキルジオールを含む、請求項3に記載のインク組成物。

【請求項5】 保湿剤を更に含む、請求項1に記載のインク組成物。

【請求項6】 前記着色剤が水溶性染料を含み、かつ、前記インク組成物が水を更に含む、請求項1に記載のインク組成物。

【請求項7】 約1～約10重量%の、水溶性染料を含む少なくとも一つの着色剤と；約4～約15重量%の、置換又は非置換のラクタムを含む補助溶媒と；約3～約6重量%の、アルキル基を形成する4～10個の炭素原子を有する1，2-アルキルジオールを含む浸透剤と；約0.1～約10重量%の、下記構造を有するポリオルガノシロキサン湿潤剤と；を含むインク組成物。

【化1】



ここで、Rは独立したC1～6アルキル基又はアリール基であり、YはA-(OCR2-CR2)m-(OCR2-CR2-CR2)n-Zであり、ZはH、OH又は、アルコキシ基であり、m、x及びyはそれぞれ独立した1以上の整数であり、nは0以上の整数であり、Aは架橋ラジカルである。

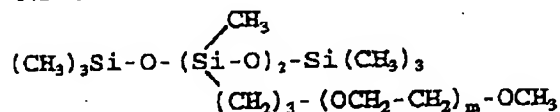
【請求項8】 約8～約17重量%の、テトラエチレングリコールを含む第2の補助溶媒を含む、請求項7に記載のインク組成物。

【請求項9】 前記ラクタムが2-ピロリドンである、請求項7に記載のインク組成物。

【請求項10】 前記1，2-アルキルジオールが1，2-ヘキサジオールである、請求項7に記載のインク組成物。

【請求項11】 前記ポリオルガノシロキサン湿潤剤が下記式を有する、請求項7に記載のインク組成物。

【化2】



ここで、mは1以上の整数である。

【請求項12】 少なくとも一つの着色剤と；湿潤剤と；置換又は非置換のラクタム、アミド、又はこれらの混合物を含む補助溶媒と；を含むインク組成物を供給する段階と、

インク泡を形成するために前記インク組成物を加熱することにより個々のインク滴を形成する段階と、

前記インク滴をノズルから噴射する段階とを含み、インク滴の誤った方向への噴射とノズル故障を低減することにより、ノズル列から基材上に液状インクを印刷する方法。

【請求項13】 前記ノズルが、約40μm未満の直径を有する、請求項12に記載の印刷方法。

【請求項14】 前記ノズルが、約30μm未満の直径を有する、請求項12に記載の印刷方法。

【請求項15】 前記個々のインク滴が約15～約25ナノグラムの量である、請求項12に記載の印刷方法。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】本発明は水性インク組成物に関し、より詳細には、インク・ジェット用インクとして通常知られる、ノズルから基材に塗布する水性インクに関する。

【0002】

【従来の技術】インク・ジェット・プリンタは、個人又はネットワーク化されたコンピュータからの印刷出力の提供を含む多くの末端での使用に対して、低コストならびに高品質の印刷オプションを提供する。通常、インク・ジェット・プリンタのプリントヘッドでは、例えば、インク・カートリッジのようなリザーバからの液状インク源を備えたチャンバ内に抵抗体要素が用いられている。プリントヘッドを形成するために、複数の抵抗体要素が所望のパターンでノズル・プレート上に配置されており、各抵抗体要素はノズル・プレート上のノズルに結合され、このノズルを通してインク滴が印刷基材に向けて噴射される。

【0003】操作中に、選択された要素を適切な時間加熱する各抵抗体に送られる信号は、マイクロプロセッサにより制御される。この加熱によりチャンバ内にインク泡が形成される。圧力の蓄積により、ノズルを通してインクが噴射される。抵抗体の発熱を制御することにより、特性印刷基材に当たるインク滴によって文字や数字が形成される。

【0004】

【発明が解決しようとする課題】インク・ジェット用インクに対して要求される性能は厳格であることが知られており、この要求される性能には、長寿命に対する要求、プリントヘッド内のインクが乾燥してノズルを詰まらせない能力、更に紙や他の基材上にひとたび印刷されれば素早く乾燥する能力が含まれる。インク・ジェット印刷が進歩して高解像度（すなわち、インチ当たりのよ

り多くのインク滴)及び高印刷品質が達成されると、ジェット・インクに対して要求される性能は一層厳しいものとなる。これは、インク・ジェット・プリンタが、より小径のノズルを通してより少量の滴(すなわち、より小径の滴)を、正確かつ高頻度で噴射できなければならないということである。したがって、この分野においては、インク・ジェット用インクが高解像度及び高速度において高印刷品質を提供するという要求が残る。

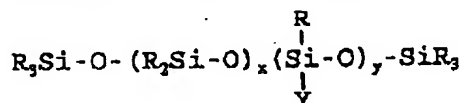
【0005】

【課題を解決するための手段】本発明は、ジェット印刷用のインキ組成物を提供することによって上記要求に応じるものであり、その結果、インク滴の誤った方向への

噴射とノズル故障が低減できる。本発明の特徴の一つによれば、提供されるインク組成物は、少なくとも一つの着色剤；例えば、置換又は非置換のラクタム、アミド又はこれらの混合物などの補助溶媒；浸透剤；及び疎水性セグメントと親水性セグメントを含む湿潤剤；を含有する。好ましくは、ラクタム補助溶媒は2-ピロリドンを含み、湿潤剤は、例えば、アルキルオキシエチレンオキシエタノールのようなアルコキシポリアルキレンオキシアルカノール、又は下記一般式を有するポリオルガノシロキサンである。

【0006】

【化3】



【0007】ここで、Rは独立したC1-6アルキル基、アリール基であり、好ましくはメチルである。YはA-(OCR2-CR2)m-(OCR2-CR2-CR2)n-Zであり、ZはH、OH又は、例えばOCH3のようなアルコキシ基であり、m、x及びyはそれぞれ独立した1以上の整数であり、nは0以上の整数であり、Aは、例えば(CR2)nのような架橋ラジカルである。このインクは、高解像度及び高速度において高印刷品質を提供する。

【0008】

【発明の実施の形態】本発明の液状インク組成物は、より小径のノズルから噴射されインク量が低減されたインク液滴を用いたときでさえ、高印刷品質を与えるジェット印刷用インクを提供する。このインク組成物は、重要な成分として、着色剤、補助溶媒及び湿潤剤を含む。ここで用いる湿潤剤という用語は、疎水性セグメントと親水性セグメントを有する化合物を意味し、界面活性剤、気泡不安定化剤及び消泡剤を含む。更に好ましい実施態様では、このインク組成物は浸透剤を含み、かつ水性ベースである。

【0009】高解像度印刷を達成するように設計されたインク・ジェット・プリンタは、約40μm未満、好ましくは約35μm未満、最も好ましくは約30μm未満の直径を有するノズルを備えたノズル・プレートに有するプリントヘッドを備える。このような小径ノズルにより、1つの液滴当たり約15〜約25ナノグラムの範囲の低減された量の液滴が噴射される。

【0010】このような小径ノズルと低減された量の液滴の使用により、用いられるインクに対して要求される性能は非常に厳しいものとなる。小さなインク液滴の低運動エネルギーが一部原因して、誤った方向への噴射とノズル故障などの問題が生じ得る。“誤った方向への噴射”とは、インク液滴が設計されたノズルからの垂直軌道移動しないことを意味する。“ノズル故障”とは、

ノズルがインク液滴を噴射するようになっているときにインク液滴が噴射されないこと、又はインク液滴が全く噴射されないようにノズルが閉塞されていることを意味する。

【0011】あらゆる特定の理論に拘束されることを望まないが、誤った方向への噴射とノズル故障は、ノズル・プレートの表面エネルギーの相違が少なくとも一部原因して生じる。インクによるノズル・プレートの湿潤が一樣でないことにより、一つ又はそれ以上のノズルの周縁でインクの溜まりができる。この溜まったインクにより、ノズルから噴射されるインク液滴の軌道は妨げられ、また、このような液滴を設計された垂直路からそらせて誤った方向へと噴射させる。誤った方向への噴射はまた、インク滴の小さな運動量に関する大きな問題となる(すなわち、インク滴は、低減された量又は低減された速度のいずれか或いは双方を有する)。更に、長期印刷中にインクの溜まりが多量になれば、このようなインクの溜まりのために、インク滴がプリントヘッドから次々に噴射されないことによりノズル故障が生じる。

【0012】誤った方向への噴射とノズル故障はまた、プリントヘッドチャンバの個々の発熱による気泡が少なくとも一部原因して生じる。連続的な発熱の間にインクを加熱するとき、インク中のガスの溶解が進行する。このような高温においてインク内のガスがほとんど溶解しないときは、発生する気泡によって連続的な発熱がじゃまされ又は完全に妨げられさえる。

【0013】本発明では、インク組成物に、アルキルオキシポリアルキレンオキシアルカノール、及び/又は、ポリオルガノシロキサンの湿潤剤を用いる。この湿潤剤は、プリントヘッド内のチャンバを発熱する際における好ましくないインク泡の形成を不安定化するだけでなく、高い湿潤性を与えるように機能する。このことは、ノズル・プレート表面でより均一な表面エネルギーが形成されるように、湿潤剤が作用してインクの表面張力を

低減するものである。この作用は、観察によれば、ノズル・プレート表面のインクの溜まりを最小限にするものである。更に、湿潤剤は、発熱チャンバ中のインクによって生じる高温下においてインク中における溶解ガスの発生により形成される泡を不安定化するだけでなく、この泡を低減するように作用する。

【0014】更に、実際に浸透剤の使用が望まれるならば、本発明のインク組成物の湿潤剤を使用することにより組成物中に用いられる浸透剤の量が低減できること

が、予期しないことに見出された。より少量の浸透剤を用いてもよく、それにも拘わらずこのような少量の浸透剤により、インクの乾燥が速い一方で好ましいことに印刷基材上の中間色のにじみが防止される。

【0015】本発明の好ましい実施態様では、液状のインク配合物は下記表1の成分を含む。

【0016】

【表1】

表1

成分	機能	重量%
染料/顔料	着色剤	1~4
EDTA	キレート剤	0~0.1
2-ピロリドン	保湿剤/補助溶媒	4~11
テトラエチレングリコール	保湿剤/補助溶媒	8~17
1, 2-ヘキサジオール	浸透剤	3~6
ポリオルガノシロキサン	湿潤剤	0.1~10
1, 2-ベンズ- イソチアゾリン-3-one	殺生剤	0~0.3
ほう酸ナトリウム	緩衝剤	0~0.75

【0017】このインクは、好ましくは約45ダイン(dynes)/cm²(45×10⁻⁵N/cm²)未満の静表面張力を有する。

【0018】着色剤

本発明において有用な着色剤には、顔料分散系と染料の双方が含まれる。この分野において知られるように、顔料分散系とは顔料と分散剤との混合物である。本発明の実施に用いることができる顔料は、従来この分野において用いられるアゾ顔料、多環式顔料、塩基性及び酸性染料レーキ、ならびに、有機及び無機顔料を含むあらゆる種類の顔料を含む。

【0019】例えば酸(Acid)染料、直接(Direct)染料、食品(Food)染料及び反応性(Reactive)染料のような、インク・ジェット用インクに通常用いられる染料は全て、本発明の着色剤として好適である。多色インク・ジェット・システムとしてシアン/マゼンタ/イエローの色コンビネーションを用いる本発明の好ましい実施態様においては、着色剤は、シアン成分としてDirect Blue 199、マゼンタ成分としてLexmark 93A(登録商標、ビーチ(Beach)らの米国特許第5,254,160号に記載されている)、及びイエロー成分としてAcid Yellow 23を含む。しかしながら、本質的には、記録媒体上にカラーの可視像を形成できる他のあらゆる染料を用いてもよく、このような染料には、アントラキノン、モノー及びジエーゾ染、フタロシアニン、ホルマザン銅錯体が含まれる。特定の染料は、Food

Black No. 2、Direct Black 168、Acid Blue 9、Acid Red 249、Reactive Black 31、Direct Black 154、Reactive Red 180、Direct Blue 86、Direct Yellow 132を含む。

【0020】インク組成物中の着色剤の量は要素の数に応じて変化させてもよいが、着色剤は通常、約1~約10重量%、より好ましくは約1~約4重量%の量(インクの全重量に基づく)で存在し、これらに包含される全ての範囲を含む。

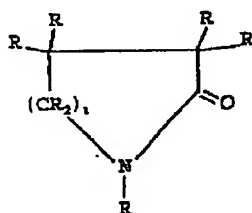
【0021】補助溶媒

本発明のインク組成物の残余は制限されない。したがって、インクは水性又は非水性であってよい。しかしながら、溶液中に着色剤を維持するのを補助しインク性能を向上させるために、補助溶媒はインク組成物中に存在する。一般に、多価アルコールのような水溶解性の有機剤が好適であり、この有機剤には、エチレングリコール；プロピレングリコール；ブチレングリコール；ジエチレングリコール；トリエチレングリコール；ヘキシレングリコール；1, 2, 6, -ヘキサントリオール及びチオジグリコールが含まれる。組成物のための他の好ましい補助溶媒には、ジオール；グリコールエステル；グリセロール；ポリエチレングリコールのようなポリアルキルグリコール；及び多価アルコールの低級アルキルエーテル；が含まれる。更に他の好ましい補助溶媒には、アルコール；アセトンのようなケトン；テトラヒドロフラン

及びジオキサンのようなエーテル；エチルアセートの
ようなエステル；スルホラン；N-メチルピロリドン；
γ-ブチラクトンのようなラクトン；ならびに、下記
の一般式を有する置換又は非置換の上述のラクタムが含まれる。

【0022】

【化4】

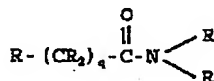


【0023】ここで、RはH、C1-6アルキル、アリール又はハロゲンであり、mは1-3の整数である。好ましい置換又は非置換のラクタムの例には、2-ピロリドン、1-メチル2-ピロリドン、及びN-(2-ヒドロキシエチル)-2-ピロリドンが含まれる。もちろん、上記化合物のいくつかの相溶性をもつブレンド及び混合物もまた用いてもよい。補助溶媒はまた、組成物中において保湿剤の機能も発揮し、インクがプリントヘッド内で乾燥するのを防止する。

【0024】補助溶媒はまた、上述のいかなる補助溶媒と共に、1°、2°及び3°のアミドを単独又は混合物で含んでいてもよい。好ましいアミド補助溶媒には、下記の一般式を有するものが含まれる。

【0025】

【化5】



【0026】ここで、Rは前述の定義の通りであり、qは0と6の間の整数である。

【0027】補助溶媒は通常、約5-約30重量%、より好ましくは約12-約28重量%の量で存在し、ここに包含される全範囲を含む。上述のように、補助溶媒の量は、インク中の他の成分に一部依存する。本発明で用いる好ましい補助溶媒には、2-ピロリドンのようなラクタム（2-50重量%、好ましくは4-15重量%）とテトラエチレングリコール（8-17重量%）との相溶性混合物が含まれる。

【0028】上述の補助溶媒と湿潤剤との組み合わせが、誤った方向への噴射とノズル故障のほとんどないインクを提供するように作用することが、予期せぬことに見出された。

【0029】浸透剤

本発明において浸透剤（界面活性剤を含む）を使用するのが好ましいときは、これらはインク組成物に添加されて印刷基材表面へのインク滴による浸透性を改善し、そして中間色のにじみ（すなわち、横方向への色のにじみ）を低減又は無くす。本発明に用いる好ましい浸透剤には、共同譲渡されたビーチ（Beach）らの米国特許第5,364,461号において教示されるような、アルキル基に4-10個の炭素原子を含有する1,2アルキルジオールが含まれる。最も好ましいものは、1,2-ヘキサンジオールと1,2-ペンタンジオールである。好ましい実施態様においては、浸透剤は約3-約6重量%の量でインク組成物中に存在する。

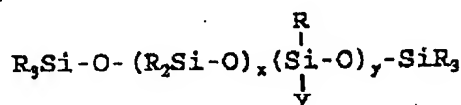
【0030】驚くべきことに、本発明のインク組成物においては低濃度の浸透剤を用いることができ、更に中間色のにじみの低減が達成されることが見出された。あらゆる特定の理論に拘束されることを望まないが、インク中の浸透剤の濃度が必要以上に低い場合に上述の湿潤剤は浸透剤との相互作用により色のにじみを低減するものと考えられる。

【0031】湿潤剤

インク滴の誤った方向への噴射とノズル故障を低減するために、本発明のインクは、アルキルオキシポリアルキレンオキシアルカノール及び／又はポリオルガノシロキサンを含む湿潤剤も含有する。特に、ポリオルガノシロキサンの好ましい種類は、下記の一般式を有する、ポリアルキレンオキサイドで修飾されたポリオルガノシロキサン共重合体である。

【0032】

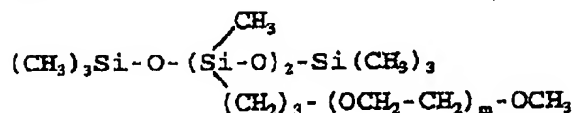
【化6】



【0033】ここで、Rはメチルであり、Yは-(CH2)3-(OCH2-CH2)m-(OCH2-CH2-CH2)n-Zであり、ZはH又はOCH3であり、m、x及びyは1以上の整数であり、nは0以上の整数である。この種類の、ポリアルキレンオキサイドで修飾されたポリオルガノシロキサン共重合体は、商業的に入手可能であり、最も好ましい組成物は下記の式を有する。

【0034】

【化7】



【0035】ここで、mは1以上の整数である。

【0036】湿潤剤は、インク組成物中においてこの組成物の約0.1-約10.0重量%、好ましくは約0.1

〜約1.0重量%の量で存在し、これに含まれる全範囲を含む。

【0037】他の任意の成分

本発明のインク組成物はまた、ジェット印刷用インク組成物に従来含まれている、キレート剤、殺生剤、粘性改良剤及び緩衝剤を含む他の望ましい成分を含んでいてもよい。金属イオン又はアルカリ金属イオンの汚染物又は不純物による有害な効能を回避するために、エチレンジアミンテトラアセテート(EDTA)のようなキレート剤を加えてもよい。通常、キレート剤は約0.1〜約1.0重量%の量で組成物に添加される。

【0038】インク内での微生物の成長を防止又は抑制するために、例えば1,2-ベンズーイソチアゾリン-3-oneのような殺生剤をインクに加えてもよい。通常、約0.1〜約0.3重量%の殺生剤を添加すれば効果を生じる。

【0039】インクを望ましいpHに調整又は維持するために、ほう酸ナトリウムのような緩衝剤もまた加えてもよい。上述のように、緩衝剤の量はインクの他の成分に依存するであろう。しかしながら、約0.25〜約0.75重量%程度の少量の緩衝剤をインクに添加するだけで、効力が生じることが見出された。

【0040】インクの調製

本発明のインクは、本質的には、水性ベースのインクを調製するためのあらゆる方法によって調製してもよい。例示のインクを調製するための好ましい手順は、次の通

りである。すなわち、染料、キレート剤(EDTA)及び脱イオン(DI)水を、約20分間攪拌しながら共に混合する。次いで、下記の成分を次々に添加し、その後約15〜20分間攪拌する。これら添加する成分は、ラクタム補助溶媒；テトラエチレングリコール補助溶媒；1,2-ヘキサジオール浸透剤；殺生剤；ほう酸ナトリウム緩衝剤；及びポリアルキレンオキサイドで修飾されたポリオルガノシロキサンである。混合段階の全ては、周囲温度で行われる。

【0041】全ての成分が添加され完全に混合されやいなや、インクのpHが測定され、pHが7.2に調整される。次いで、インク組成物はろ過され、あらゆる固形分又は特定物質が回収される。

【0042】

【実施例】本発明をより容易に理解するために、以下に実施例を示す。これらは本発明の例示であって、本発明の範囲を限定するものと解釈すべきでない。

【0043】比較例1〜比較例3

まず、比較例として下記表2〜表4に示す成分を含有する3種類のインク配合物を調製した。これらの比較例のインクには、2-ピロリドン又はポリオキシアルキレンで修飾したポリオルガノシロキサンは全く含まれていない。

【0044】

【表2】

表2 (比較例1)

成分	重量%
Direct Blue 199	2.25
EDTA	0.01
テトラエチレングリコール	20.0
1,2-ヘキサジオール	6.0
1,2-ベンズー イソチアゾリン-3-one	0.2
ほう酸ナトリウム	0.5
DI水	残余

【0045】

【表3】

表3 (比較例2)

成分	重量%
マゼンタ 93A	2.25
EDTA	0.01
テトラエチレングリコール	20.0
1, 2-ヘキサンジオール	6.5
1, 2-ベンズー	
イソチアゾリン-3-one	0.2
ほう酸ナトリウム	0.5
DI水	残余

【0046】

【表4】

表4 (比較例3)

成分	重量%
Direct Yellow 132	2.00
EDTA	0.01
テトラエチレングリコール	20.0
1, 2-ヘキサンジオール	7.0
1, 2-ベンズー	
イソチアゾリン-3-one	0.2
ほう酸ナトリウム	0.5
DI水	残余

【0047】実施例1～実施例4

【0048】

次に、実施例として下記表5～表8に示す成分を含有する、本発明に係る4種類のインク配合物を調製した。

【表5】

表5 (実施例1)

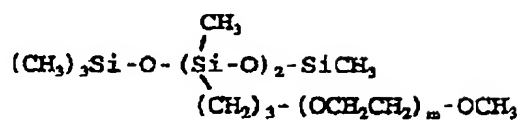
成分	重量%
Direct Blue 199	3.00
EDTA	0.01
2-ピロリドン	7.5
テトラエチレングリコール	12.5
1, 2-ヘキサンジオール	4.0
1, 2-ベンズー	
イソチアゾリン-3-one	0.2
ほう酸ナトリウム	0.2
ポリオルガノシロキサン ¹⁾	0.5
DI水	残余

¹⁾ については別途記載する。

【0049】表5中の1) は下記式を有する。

【0050】

【化8】



【0051】

【表6】

表6 (実施例2)

成分	重量%
マゼンタ 93A ²⁾	3.00
EDTA	0.01
2-ピロリドン	7.5
テトラエチレングリコール	12.5
1,2-ヘキサジオール	4.0
1,2-ベンズー	
イソチアゾリン-3-one	0.2
ほう酸ナトリウム	0.2
ポリオルガノシロキサン ³⁾	0.5
DI水	残余

²⁾ 米国特許第5,254,160号³⁾ については別途記載する。

【0052】表6中の3)は下記式を有する。

【0054】

【0053】

【表7】

【化9】

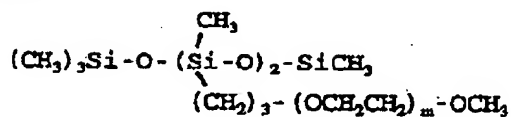


表7 (実施例3)

成分	重量%
Acid Yellow 23	3.25
EDTA	0.01
2-ピロリドン	7.5
テトラエチレングリコール	12.5
1,2-ヘキサジオール	4.0
1,2-ベンズー	
イソチアゾリン-3-one	0.2
ほう酸ナトリウム	0.2
ポリオルガノシロキサン ⁴⁾	0.5
DI水	残余

⁴⁾ については別途記載する。

【0055】表7中の4)は下記式を有する。

【0057】

【0056】

【表8】

【化10】

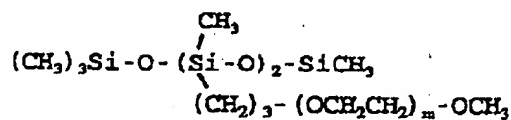


表8 (実施例4)

成分	重量%
Acid Yellow 23	8.25
EDTA	0.01
2-ピロリドン	7.5
テトラエチレングリコール	12.5
1, 2-ヘキサジオール	4.0
1, 2-ベンズー	
イソチアゾリン-3-one	0.2
ほう酸ナトリウム	0.2
アルキルオキシポリエチレンオキシエタノール	0.5
DI水	残余

【0059】実施例5 (性能試験)

本発明のインクと比較例のインクは、複数のノズルを有するプリントヘッドを備えた高解像度の3色インク・ジェット・プリンタでその性能を試験した。上記比較例1、比較例2及び比較例3のインクを用いて3つの試験を行ない(比較試験1～比較試験3)、その結果の平均値を求めた。また、本発明のインク(すなわち、上記実施例1～実施例3)を用いて2つの性能試験を行い(試

験1、試験2)、その結果の平均値も求めた。これら性能試験は、プリントヘッドのノズルから噴射したインク滴を観察することにより、インク滴の誤った方向への噴射とノズル故障(すなわち、ノズルの閉塞又はインク滴が噴射しないこと)を調べた。結果を表9に示す。

【0060】

【表9】

表9

インク	ノズル故障	誤った方向への噴射
比較試験1	6	7
比較試験2	3	2
比較試験3	5	5
平均	4.7	4.7
試験1	0	0
試験2	0	0
平均	0	0

【0061】表9において見られるように、本発明のインク組成物では、試験1と試験2の双方において、インク滴の誤った方向への噴射とノズル故障のいずれも全く発生しなかった。これに対して各比較例のインク組成物では、各比較試験において、インク滴の誤った方向への噴射とノズル故障のいずれもが相当数発生した。また、ノズル・プレート表面に流出したインク量を観察したところ、本発明のインクの方が各比較例のインクよりも少

量であり、そのため本発明のインクは高頻度で作用することができる(すなわち、より速く連続的に発熱できる)。

【0062】本発明を説明する目的のために代表的な実施態様と詳細とを示したが、本発明の範囲を逸脱することなく、ここで開示した方法及び装置を様々に変更できることは当業者には明らかであろう。

フロントページの続き

(72)発明者 テレンス・エドワード・フレイニー
アメリカ合衆国 40503 ケンタッキー、
レキシントン、ロクスバーグ・ドライブ
3243

(72)発明者 アショク・ビシュヌ・ガンガル
アメリカ合衆国 40503 ケンタッキー、
レキシントン、ウェスターフィールド・ウ
ェイ 413

(72)発明者 アグネス・カム・ジンマー
アメリカ合衆国 40514 ケンタッキー、
レキシントン、コロナ・ドライブ 1413

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(22)Date of filing : 27.03.1998

(72)Inventor : MCCAIN SANDRA H
FRANEY TERENCE E
GANGAL ASHOK V
ZIMMER AGNES K

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(54) INK COMPOSITION AND PRINTING PROCESS USING THE SAME

(57)Abstract:

PROBLEM TO BE SOLVED: To obtain an ink jet ink being less problematic in jetting ink drops in incorrect directions and in nozzle accidents and giving a high-quality high-resolution print at a high speed by mixing at least one colorant with a wetting agent and a first cosolvent comprising a substituted or unsubstituted lactam or amide or a mixture thereof.

SOLUTION: This ink desirably contains a penetrant in addition to the above components and is a water-base one. As a second cosolvent for the colorant, desirably about 8 to 17 wt.% tetraethylene glycol is used, and the first cosolvent used in combination with this is a lactam (e.g. 2-pyrrolidone) in an amount of about 4 to 15 wt.%. The penetrant used is a polyorganosiloxane and is used in an amount of about 0.1 to 10 wt.%. Other desirable additives include a chelating agent (e.g. EDTA), a biocide, a viscosity improver and a buffer (e.g. sodium borate).

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[The technical field to which invention belongs] this invention relates to a detail more about a water-color-ink constituent at the water color ink which is usually known as ink for ink jets and which is applied to a base material from a nozzle.

[0002]

[Description of the Prior Art] An ink jet printer provides a low-cost row with a quality printing option to use at many the ends including an individual or offer of the printout from a computer connected by network. Usually, in the print head of an ink jet printer, the resistor element is used into the chamber equipped with the source of liquefied ink from a reservoir like an ink cartridge, for example. In order to form a print head, two or more resistor elements are arranged on the nozzle plate by the desired pattern, each resistor element is combined with the nozzle on a nozzle plate, and an ink drop is injected towards a printing base material through this nozzle.

[0003] The signal with which the selected element is sent during operation by each suitable resistor which carries out time heating is controlled by the microprocessor. An ink bubble is formed in a chamber of this heating. Ink is injected through a nozzle by accumulation of a pressure. By controlling generation of heat of a resistor, a character and a number are formed of the ink drop which hits a property printing base material.

[0004]

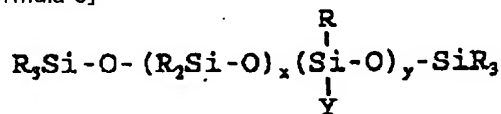
[Problem(s) to be Solved by the Invention] It is known that the performance demanded from the ink for ink jets is strict, and once it is further printed on paper or other base materials, the demand which receives long lasting, the capacity which the ink in a print head dries and a nozzle does not block, and the capacity dried quickly are included in this performance demanded. If ink-jet printing progresses and high resolution (namely, per inch many ink drops) and high printing quality are attained, the performance required of Jet, Inc. will become still severer. I hear that an ink jet printer must be able to inject a more nearly little drop (namely, more drop of a minor diameter) by accuracy and high frequency through the nozzle of a minor diameter more, and this has it. Therefore, in this field, high resolution and demand of setting at high speed and offering high printing quality remain [the ink for ink jets].

[0005]

[Means for Solving the Problem] this invention can reduce the injection to a direction and nozzle failure which the ink drop mistook according to the above-mentioned demand by offering the ink constituent for jet printing. according to one of the features of this invention, the ink constituent offered contains wetting-agent; containing auxiliary solvent; penetrating agent; and a hydrophobic segment and hydrophilic segments, such as an unsubstituted lactam, at least one coloring agent; for example, substitution, or, amides, or such mixture Preferably, a lactam auxiliary solvent is a polyorganosiloxane which has alkoxy polyalkylene oxy-alkanol [like for example alkyloxy ethyleneoxy ethanol including 2-pyrrolidone] whose wetting agent is, or the following general formula.

[0006]

[Formula 3]



[0007] Here, R is the independent C1-6 alkyl group and the independent aryl group, and is a methyl preferably. Y is A-(OCR2-CR2) m-(OCR2-CR2-CR2) n-Z, Z is H, OH, or an alkoxy group like OCH3, mx and y are one or more independent integers, respectively, n is zero or more integers, and A is a bridge formation radical like n (CR2). This ink offers high printing quality in high resolution and high speed.

[0008]

[Embodiments of the Invention] The liquefied ink constituent of this invention offers the ink for jet printing which gives high printing quality, even when the ink drop by which it was injected more from the nozzle of a minor diameter, and the amount of ink was reduced is used. This ink constituent contains a coloring agent, an auxiliary solvent, and a wetting agent as an important component. A term called the wetting agent used here means the compound which has a hydrophobic segment and a hydrophilic segment, and contains a surfactant, a cellular destabilization agent, and a defoaming agent. Furthermore, in the desirable embodiment, this ink constituent is the aquosity base, including a penetrating agent.

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[0009] The ink jet printer designed so that high resolution printing might be attained is equipped with the print head which has the nozzle plate preferably equipped with less than about 35 micrometers of less than about 40 micrometers of nozzles which have the diameter of less than about 30 micrometers. The drop of an amount by which the range per [15 / about] drop - of 25 nanograms of abbreviation was reduced is injected by such minor diameter nozzle.

[0010] The performance demanded from the ink used by use of the drop of such a minor diameter nozzle and the reduced amount will become very severe. A part of hypomotility energy of a small ink drop results, and the mistaken problems, such as injection to a direction and nozzle failure, may arise. "Injection to the mistaken direction" means not moving the perpendicular orbit from the nozzle with which the ink drop was designed. "Nozzle failure" means that an ink drop is not injected or that the nozzle is blockaded so that an ink drop may not be injected at all, when a nozzle injects an ink drop.

[0011] Although it does not desire to be restrained by all specific theory, a difference of the surface energy of a nozzle plate results in part at least, and produces the mistaken injection to a direction and mistaken nozzle failure. According to it not being uniform, ink collects and the humidity of the nozzle plate in ink can ** in the periphery of the nozzle beyond one or it. The orbit of the ink drop injected from a nozzle is made to inject in this collected ink in the direction which was made to shave from the perpendicular way which it was barred [way] and had such a drop designed, and was mistaken. The injection to the mistaken direction poses a big problem about a small momentum of an ink drop again (that is, an ink drop has either or the both sides of the reduced amount or the reduced speed). Furthermore, if ***** of ink becomes abundant during long-term printing, since such ink will collect, nozzle failure arises by not injecting an ink drop one after another from a print head.

[0012] The air bubbles by each generation of heat of a print head chamber result in part at least, and produce the mistaken injection to a direction and mistaken nozzle failure again. When heating ink between continuous generation of heat, the dissolution of the gas in ink advances. When the gas in ink hardly dissolves in such an elevated temperature, continuous generation of heat is ***** (ed) by the generated air bubbles, or it is barred completely and carries out [it is clear and].

[0013] In this invention, alkyloxy polyalkylene oxy-alkanol and/or the wetting agent of a polyorganosiloxane are used for an ink constituent. This wetting agent not only destabilizes formation of the ink bubble at the time of generating heat the chamber in a print head which is not desirable, but functions as giving a high wettability. A wetting agent acts and this reduces the surface tension of ink so that more uniform surface energy may be formed on a nozzle plate front face. According to observation, this operation makes the minimum ***** of the ink on the front face of a nozzle plate. Furthermore, a wetting agent not only destabilizes the bubble which sets under the elevated temperature produced in the ink in an exoergic chamber, and is formed of generating of the solution gas in ink, but acts so that this bubble may be reduced.

[0014] Furthermore, if use of a penetrating agent was actually desired, it was found out by that that the amount of the penetrating agent used into a constituent can be reduced does not expect by using the wetting agent of the ink constituent of this invention. A small amount of penetrating agent may be used; and while dryness of ink is quick by such a small amount of penetrating agent in spite of it, bleeding of the neutral colors on a printing base material is prevented by the desirable thing.

[0015] In the desirable embodiment of this invention, a liquefied ink compound contains the component of the following table 1.

[0016]

[Table 1]

表 1

成分	機能	重量%
染料/顔料	着色剤	1 ~ 4
EDTA	キレート剤	0 ~ 0.1
2-ピロリドン	保湿剤/補助溶媒	4 ~ 11
テトラエチレングリコール	保湿剤/補助溶媒	8 ~ 17
1, 2-ヘキサジオール	浸透剤	3 ~ 6
ポリオルガノシロキサン	湿润剤	0.1 ~ 10
1, 2-ベンズ		
イソチアゾリン-3-one	殺生剤	0 ~ 0.3
ほう酸ナトリウム	緩衝剤	0 ~ 0.75

[0017] This ink has ***** of about 45 dynes (dynes)/under cm² (45x10⁻⁵ N/cm²) preferably.

[0018] In a coloring agent this invention, the both sides of a pigment-content powder system and a color are included in a useful coloring agent. As known in this field, a pigment-content powder system is the mixture of a pigment and a dispersant. The pigment which can be used for operation of this invention contains all the kinds that

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contain organic and an inorganic pigment in the azo pigment and polycyclic formula pigment which are conventionally used in this field, base and an acid-dye lake, and a row of pigment.

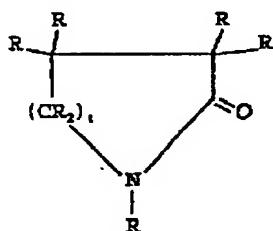
[0019] For example, all of an acid (Acid) color and the color usually used for ink for ink jets directly (Direct) like a color, a food (Food) color, and a reactant (Reactive) color are suitable as a coloring agent of this invention. Setting in the desirable embodiment of this invention using the color combination of cyanogen / Magenta / yellow as a multicolor ink-jet system, a coloring agent is Direct as a cyano component. It is Lexmark as Blue199 and a Magenta component. It is Acid as 93A (indicated by U.S. Pat. No. 5,254,160 of registered trademarks and beaches (Beach)), and a yellow component. Yellow 23 is included. However, all the colors of the others which can form the visible image of a color on a record medium may essentially be used, and anthraquinone, Monod and a G azo stain, a phthalocyanine, and a HORUMAZAN copper complex are contained in such a color. A specific color is Food. Black No.2, Direct Black 168 Acid Blue9, Acid Red 249 Reactive Black 31 Direct Black 154 Reactive Red 180 Direct Blue 86 Direct Yellow 132 is included.

[0020] Although the amount of the coloring agent in an ink constituent may be changed according to the number of elements, usually, about 1 - 10 % of the weight of abbreviation, a coloring agent exists in the amount (based on the total weight of ink) of about 1 - 4 % of the weight of abbreviation, and includes more preferably all the ranges included by these.

[0021] The remainder of the ink constituent of an auxiliary solvent this invention is not restricted. Therefore, ink may be water or non-water. However, in order to assist maintaining a coloring agent in a solution and to raise an ink performance, an auxiliary solvent exists in an ink constituent. Generally, the organic agent of dissolved water in fuel like polyhydric alcohol is suitable, and ethylene glycol; propylene-glycol; butylene-glycol; diethylene-glycol; triethylene-glycol; hexylene-glycol; 1, 2 and 6, - hexane triol, and a thiodiglycol are contained in this organic agent. Poly alkyl glycol; like a diol; glycol-ester; glycerol; polyethylene glycol and low-grade alkyl ether; of polyhydric alcohol are contained in other desirable auxiliary solvents for a constituent. Furthermore, a ketone; tetrahydrofuran like [other desirable auxiliary solvents] alcoholic; acetone and lactone like ester; sulfolane; N-methyl pyrrolidone; γ-butyl lactone like ether; ethyl acetate like a dioxane; an above-mentioned lactam the substitution which has the following general formula, or unsubstituted is contained in a row.

[0022]

[Formula 4]

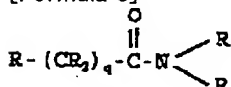


[0023] Here, R is H, C1-6 alkyl, an aryl, or a halogen, and t is the integer of 1-3. 2-pyrrolidone, a 1-methyl 2-pyrrolidone, and an N-(2-hydroxyethyl)-2-pyrrolidone are contained in desirable substitution or the desirable example of an unsubstituted lactam. Of course, you may also use a blend and mixture with some compatibility of the above-mentioned compound. It prevents that an auxiliary solvent also demonstrates the function of a moisturizer in a constituent, and ink dries it within a print head again.

[0024] The auxiliary solvent may contain the amide (1 degree, 2 degrees, and 3 degrees) with independent or mixture with what above-mentioned auxiliary solvent again. What has the following general formula is contained in a desirable amide auxiliary solvent.

[0025]

[Formula 5]



[0026] Here, R is as the above-mentioned definition and q is an integer between 0 and 6.

[0027] Usually, about 5 - 30 % of the weight of abbreviation, an auxiliary solvent exists in the amount of about 12 - 28 % of the weight of abbreviation, and includes more preferably all the ranges included here. As mentioned above, it depends for the amount of an auxiliary solvent on other components in ink in part. The compatibility mixture of the lactam (2 - 50 % of the weight, preferably 4 - 15 % of the weight) and tetraethylene glycol (8 - 17 % of the weight) like 2-pyrrolidone is contained in the desirable auxiliary solvent used by this invention.

[0028] It was found out by that acting so that the ink in which the combination of an above-mentioned auxiliary solvent and a wetting agent does not almost have the injection to the mistaken direction and nozzle failure may be offered does not expect.

[0029] When it is desirable to use a penetrating agent (for a surfactant to be included) in a penetrating agent this invention, it is added by the ink constituent and these improve the permeability by the ink drop to a printing base-

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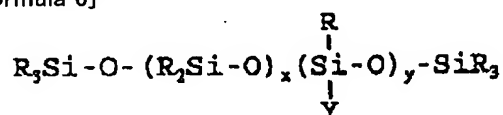
material front face, are reduced and lose bleeding (namely, bleeding of a lateral color) of neutral colors. 1 and 2 alkyl diol which contain 4-10 carbon atoms in an alkyl group which is taught in U.S. Pat. No. 5,364,461 of the beaches (Beach) by which joint transfer was carried out are contained in the desirable penetrating agent used for this invention. The most desirable things are 1 and 2-hexandiol and 1 and 2-pentanediol. In a desirable embodiment, a penetrating agent exists in an ink constituent in the amount of about 3 - 6 % of the weight of abbreviation.

[0030] Especially, the low-concentration penetrating agent could be used in the ink constituent of this invention, and the surprising thing for which reduction of bleeding of neutral colors is attained further was found out. Although it does not desire to be restrained by all specific theory, when the concentration of the penetrating agent in ink is lower than required, it is thought that an above-mentioned wetting agent reduces bleeding of a color according to an interaction with a penetrating agent.

[0031] In order to reduce the injection to a direction and nozzle failure which the wetting-agent ink drop mistook, the ink of this invention also contains the wetting agent containing alkyloxy polyalkylene oxy-alkanol and/or a polyorganosiloxane. Especially the desirable kind of polyorganosiloxane is a polyorganosiloxane copolymer which has the following general formula and which was embellished with polyalkylene oxide.

[0032]

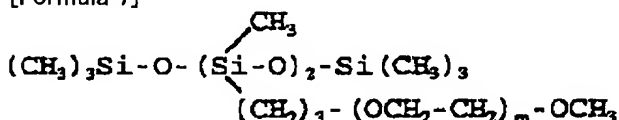
[Formula 6]



[0033] R is a methyl, Y is $-(\text{CH}_2)_3-(\text{OCH}_2-\text{CH}_2)_m-(\text{OCH}_2-\text{CH}_2-\text{CH}_2)_n-\text{Z}$ here, Z is H or OCH_3 , mx and y are one or more integers, and n is zero or more integers. As for the polyorganosiloxane copolymer embellished with this kind of polyalkylene oxide, the available and most desirable constituent has the following formula commercially.

[0034]

[Formula 7]



[0035] Here, m is one or more integers.

[0036] A wetting agent exists preferably in an ink constituent in the amount of about 0.1 - 1.0 % of the weight of abbreviation about 0.1 of this constituent - 10.0 % of the weight of abbreviation, and includes all the ranges included by this.

[0037] The ink constituent of other arbitrary component this inventions may contain other desirable components which contain the chelating agent and destruction-of-life agent which are conventionally contained in the ink constituent for jet printing, a viscous improvement agent, and a buffer again. In order to avoid the detrimental effect by the contamination or impurity of a metal ion or alkali-metal ion, you may add a chelating agent like ethylenediamine tetrapod acetate (EDTA). Usually, a chelating agent is added by the constituent in the amount of about 0.1 - 1.0 % of the weight of abbreviation.

[0038] in order to prevent or suppress the microbiological growth within ink -- for example, 1 and 2-bends - iso -- you may add a destruction-of-life agent like thiazoline-3-one to ink. Usually, an effect will be produced if the destruction-of-life agent of about 0.1 - 0.3 % of the weight of abbreviation is added.

[0039] In order to adjust or maintain ink to desirable pH, you may also add a buffer like way acid sodium. As mentioned above, it will depend for the amount of a buffer on other components of ink. However, it was found out only by adding a small amount of buffer of about 0.25 - about 0.75 % of the weight of abbreviation in ink that effect arises.

[0040] Essentially, you may prepare the ink of the manufacture this invention of ink by all the methods for preparing the ink of the water base. The desirable procedure for preparing the ink of instantiation is as follows. That is, a color, a chelating agent (EDTA), and deionization (DI) water are mixed [both], agitating for about 20 minutes. Subsequently, it adds one after another and the following component is agitated for about 15 - 20 minutes after that. The these-added component is the polyorganosiloxane embellished with lactam auxiliary solvent; tetraethylene-glycol auxiliary solvent; 1 and 2 hexandiol penetrating agent; destruction-of-life agent; way acid sodium buffer; and polyalkylene oxide. All the mixing stages are performed with ambient temperature.

[0041] All components are added, it is mixed completely, pH of ***** and ink is measured, and pH is adjusted to 7.2. Subsequently, an ink constituent is filtered and all solid contents or special material are collected.

[0042]

[Example] In order to understand this invention more easily, an example is shown below. These are instantiation of this invention and should not interpret it as what limits the range of this invention.

[0043] the example 1 of comparison - the example 3 of comparison -- three kinds of ink compounds which contain first the component shown in following Table 2 - 4 as an example of comparison were prepared The polyorganosiloxane embellished with 2-pyrrolidone or polyoxyalkylene is not contained in the ink of these examples of comparison at all.

[0044]

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[Table 2]

表 2 (比較例 1)

成分	重量%
Direct Blue 199	2.25
EDTA	0.01
テトラエチレングリコール	20.0
1, 2-ヘキサンジオール	6.0
1, 2-ベンズ-	
イソチアゾリン-3-one	0.2
ほう酸ナトリウム	0.5
DI水	残余

[0045]

[Table 3]

表 3 (比較例 2)

成分	重量%
マゼンタ 93A	2.25
EDTA	0.01
テトラエチレングリコール	20.0
1, 2-ヘキサンジオール	6.5
1, 2-ベンズ-	
イソチアゾリン-3-one	0.2
ほう酸ナトリウム	0.5
DI水	残余

[0046]

[Table 4]

表 4 (比較例 3)

成分	重量%
Direct Yellow 132	2.00
EDTA	0.01
テトラエチレングリコール	20.0
1, 2-ヘキサンジオール	7.0
1, 2-ベンズ-	
イソチアゾリン-3-one	0.2
ほう酸ナトリウム	0.5
DI水	残余

[0047] Four kinds of ink compounds containing the component shown in following Table 5 - 8 as an example 1 - an example 4, next an example concerning this invention were prepared.

[0048]

[Table 5]

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表 5 (実施例 1)

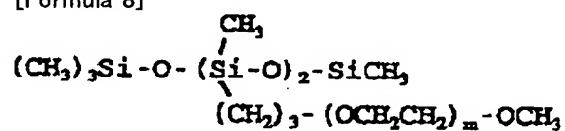
成分	重量%
Direct Blue 199	3.00
EDTA	0.01
2-ピロリドン	7.5
テトラエチレングリコール	12.5
1, 2-ヘキサンジオール	4.0
1, 2-ベンズー	
イソチアゾリン-3-one	0.2
ほう酸ナトリウム	0.2
ポリオルガノシロキサン ¹⁾	0.5
D I 水	残余

¹⁾ については別途記載する。

[0049] One in Table 5 has the following formula.

[0050]

[Formula 8]



[0051]

[Table 6]

表 6 (実施例 2)

成分	重量%
マゼンタ 93 A ²⁾	3.00
EDTA	0.01
2-ピロリドン	7.5
テトラエチレングリコール	12.5
1, 2-ヘキサンジオール	4.0
1, 2-ベンズー	
イソチアゾリン-3-one	0.2
ほう酸ナトリウム	0.2
ポリオルガノシロキサン ³⁾	0.5
D I 水	残余

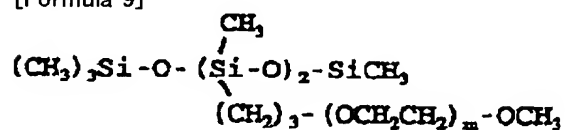
²⁾ 米国特許第 5, 254, 160 号

³⁾ については別途記載する。

[0052] Three in Table 6 has the following formula.

[0053]

[Formula 9]



[0054]

[Table 7]

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表 7 (実施例 3)

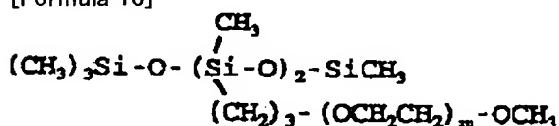
成分	重量%
Acid Yellow 23	3.25
EDTA	0.01
2-ピロリドン	7.5
テトラエチレングリコール	12.5
1, 2-ヘキサンジオール	4.0
1, 2-ベンズー	
イソチアゾリン-3-one	0.2
ほう酸ナトリウム	0.2
ポリオルガノシロキサン ⁴⁾	0.5
DI水	残余

⁴⁾ については別途記載する。

[0055] Four in Table 7 has the following formula.

[0056]

[Formula 10]



[0057]

[Table 8]

表 8 (実施例 4)

成分	重量%
Acid Yellow 23	3.25
EDTA	0.01
2-ピロリドン	7.5
テトラエチレングリコール	12.5
1, 2-ヘキサンジオール	4.0
1, 2-ベンズー	
イソチアゾリン-3-one	0.2
ほう酸ナトリウム	0.2
アルキルオキシポリエチレンオキシエタノール	0.5
DI水	残余

[0059] Example 5 (performance test)

The ink of this invention and the ink of the example of comparison examined the performance with 3 color ink jet printer of the high resolution equipped with the print head which has two or more nozzles. Three examinations were performed using the ink of the above-mentioned example 1 of comparison, the example 2 of comparison, and the example 3 of comparison (the comparison examination 1 - comparison examination 3), and the average of the result was calculated. Moreover, two performance tests were performed using the ink (namely, the above-mentioned example 1 - an example 3) of this invention (examination 1, examination 2), and the average of the result was also calculated. These performance tests investigated the injection to a direction and nozzle failure (that is, lock out or ink drop of a nozzle should not inject) which the ink drop mistook by observing the ink drop injected from the nozzle of a print head. A result is shown in Table 9.

[0060]

[Table 9]

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表 9

インク	ノズル故障	誤った方向への噴射
比較試験 1	6	7
比較試験 2	3	2
比較試験 3	5	5
平均	4. 7	4. 7
試験 1	0	0
試験 2	0	0
平均	0	0

[0061] In the ink constituent of this invention, the injection to the direction which the ink drop mistook, and neither of nozzle failure were generated at all in the both sides of examination 1 and examination 2 so that it might see in Table 9. on the other hand, the injection to the direction which the ink drop mistook by the ink constituent of each example of comparison in each comparison examination and all of nozzle failure — although — it acted as several considerable shot student Moreover, when the amount of ink which flowed into the nozzle plate front face is observed, the ink of this invention is more nearly little than the ink of each example of comparison, therefore the ink of this invention can act by high frequency (that is, it can generate heat continuously more quickly).

[0062] Although an embodiment and a detail typical for the purpose explaining this invention were shown, probably, it will be clear to this contractor that the method and equipment which were indicated here can be changed variously, without deviating from the range of this invention.

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CLAIMS

[Claim(s)]

[Claim 1] The 1st auxiliary solvent containing at least one coloring agent,; wetting agent,; substitution or an unsubstituted lactam, amides, or such mixture, and the ink constituent containing,.

[Claim 2] The ink constituent containing the 2nd auxiliary solvent for the aforementioned coloring agent according to claim 1.

[Claim 3] The ink constituent according to claim 1 which contains a penetrating agent further.

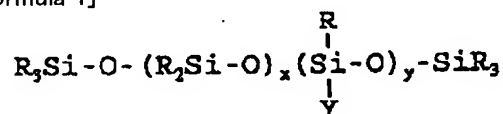
[Claim 4] The ink constituent according to claim 3 with which the aforementioned penetrating agent contains 1 and 2-alkyl diol which has 4-10 carbon atoms which form an alkyl group.

[Claim 5] The ink constituent according to claim 1 which contains a moisturizer further.

[Claim 6] The ink constituent according to claim 1 with which the aforementioned ink constituent contains [the aforementioned coloring agent] water further, including a dissolved-water-in-fuel color.

[Claim 7] about 1- at least one coloring agent containing about 10% of the weight of a dissolved-water-in-fuel color, and; about 4- the auxiliary solvent containing about 15% of the weight of substitution, or an unsubstituted lactam, and; about 3- the penetrating agent containing 2-alkyl diol, and 1 which has 4-10 carbon atoms which form about 6% of the weight of alkyl group, and; about 0.1- the ink constituent containing the polyorganosiloxane wetting agent which has about 10% of the weight of the following structure, and;

[Formula 1]



R is the independent C1-6 alkyl group or the independent aryl group here, Y is A-(OCR2-CR2) m-(OCR2-CR2- CR2) n-Z, Z is H, OH, or an alkoxy group, mx and y are one or more independent integers, respectively, n is zero or more integers, and A is a bridge formation radical.

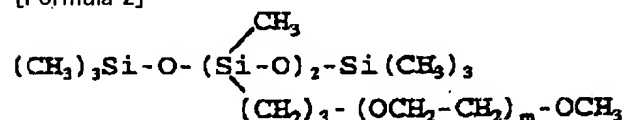
[Claim 8] The ink constituent containing the 2nd auxiliary solvent containing the tetraethylene glycol of about 8 - 17 % of the weight of abbreviation according to claim 7.

[Claim 9] The ink constituent according to claim 7 whose aforementioned lactam is 2-pyrrolidone.

[Claim 10] The ink constituent according to claim 7 the above 1 and whose 2-alkyl diol are 1 and 2-hexandiol.

[Claim 11] The ink constituent according to claim 7 with which the aforementioned polyorganosiloxane wetting agent has the following formula.

[Formula 2]



Here, m is one or more integers.

[Claim 12] The auxiliary solvent containing at least one coloring agent,; wetting agent,; substitution or an unsubstituted lactam, amides, or such mixture, and the stage which supplies the ink constituent containing, By reducing the injection to the direction which the ink drop mistook including the stage which forms each ink drop by heating the aforementioned ink constituent in order to form an ink bubble, and the stage which injects the aforementioned ink drop from a nozzle, and nozzle failure How to print liquefied ink on a base material from a nozzle train.

[Claim 13] The printing method according to claim 12 that the aforementioned nozzle has the diameter of less than about 40 micrometers.

[Claim 14] The printing method according to claim 12 that the aforementioned nozzle has the diameter of less than about 30 micrometers.

[Claim 15] The printing method according to claim 12 which is the amount each aforementioned ink drops of whose are about 15 - 25 nanograms of abbreviation.

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TECHNICAL FIELD

[The technical field to which invention belongs] this invention relates to a detail more about a water-color-ink constituent at the water color ink which is usually known as ink for ink jets and which is applied to a base material from a nozzle.

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PRIOR ART

[Description of the Prior Art] An ink jet printer provides a low-cost row with a quality printing option to use at many the ends including an individual or offer of the printout from a computer connected by network. Usually, in the print head of an ink jet printer, the resistor element is used into the chamber equipped with the source of liquefied ink from a reservoir like an ink cartridge, for example. In order to form a print head, two or more resistor elements are arranged on the nozzle plate by the desired pattern, each resistor element is combined with the nozzle on a nozzle plate, and an ink drop is injected towards a printing base material through this nozzle.

[0003] The signal with which the selected element is sent during operation by each suitable resistor which carries out time heating is controlled by the microprocessor. An ink bubble is formed in a chamber of this heating. Ink is injected through a nozzle by accumulation of a pressure. By controlling generation of heat of a resistor, a character and a number are formed of the ink drop which hits a property printing base material.

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] It is known that the performance demanded from the ink for ink jets is strict, and once it is further printed on paper or other base materials, the demand which receives long lasting, the capacity which the ink in a print head dries and a nozzle does not block, and the capacity dried quickly are included in this performance demanded. If ink-jet printing progresses and high resolution (namely, per inch many ink drops) and high printing quality are attained, the performance required of Jet, Inc. will become still severer. I hear that an ink jet printer must be able to inject a more nearly little drop (namely, more drop of a minor diameter) by accuracy and high frequency through the nozzle of a minor diameter more, and this has it. Therefore, in this field, high resolution and demand of setting at high speed and offering high printing quality remain [the ink for ink jets].

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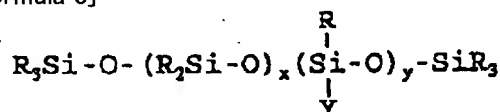
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MEANS

[Means for Solving the Problem] this invention can reduce the injection to a direction and nozzle failure which the ink drop mistook according to the above-mentioned demand by offering the ink constituent for jet printing. according to one of the features of this invention, the ink constituent offered contains wetting-agent; containing auxiliary solvent; penetrating agent; and a hydrophobic segment and hydrophilic segments, such as an unsubstituted lactam, at least one coloring agent; for example, substitution, or, amides, or such mixture Preferably, a lactam auxiliary solvent is a polyorganosiloxane which has alkoxy polyalkylene oxy-alkanol [like for example alkyloxy ethyleneoxy ethanol including 2-pyrrolidone] whose wetting agent is, or the following general formula.

[0006]

[Formula 3]



[0007] Here, R is the independent C1-6 alkyl group and the independent aryl group, and is a methyl preferably. Y is A-(OCR2-CR2) m-(OCR2-CR2-CR2) n-Z, Z is H, OH, or an alkoxy group like OCH3, mx and y are one or more independent integers, respectively, n is zero or more integers, and A is a bridge formation radical like n (CR2). This ink offers high printing quality in high resolution and high speed.

[0008]

[Embodiments of the Invention] The liquefied ink constituent of this invention offers the ink for jet printing which gives high printing quality, even when the ink drop by which it was injected more from the nozzle of a minor diameter, and the amount of ink was reduced is used. This ink constituent contains a coloring agent, an auxiliary solvent, and a wetting agent as an important component. A term called the wetting agent used here means the compound which has a hydrophobic segment and a hydrophilic segment, and contains a surfactant, a cellular destabilization agent, and a defoaming agent. Furthermore, in the desirable embodiment, this ink constituent is the aqueous base, including a penetrating agent.

[0009] The ink jet printer designed so that high resolution printing might be attained is equipped with the print head which has the nozzle plate preferably equipped with less than about 35 micrometers of less than about 40 micrometers of nozzles which have the diameter of less than about 30 micrometers. The drop of an amount by which the range per [15 / about] drop - of 25 nanograms of abbreviation was reduced is injected by such minor diameter nozzle.

[0010] The performance demanded from the ink used by use of the drop of such a minor diameter nozzle and the reduced amount will become very severe. A part of hypomotility energy of a small ink drop results, and the mistaken problems, such as injection to a direction and nozzle failure, may arise. "Injection to the mistaken direction" means not moving the perpendicular orbit from the nozzle with which the ink drop was designed. "Nozzle failure" means that an ink drop is not injected or that the nozzle is blockaded so that an ink drop may not be injected at all, when a nozzle injects an ink drop.

[0011] Although it does not desire to be restrained by all specific theory, a difference of the surface energy of a nozzle plate results in part at least, and produces the mistaken injection to a direction and mistaken nozzle failure. According to it not being uniform, ink collects and the humidity of the nozzle plate in ink can ** in the periphery of the nozzle beyond one or it. The orbit of the ink drop injected from a nozzle is made to inject in this collected ink in the direction which was made to shave from the perpendicular way which it was barred [way] and had such a drop designed, and was mistaken. The injection to the mistaken direction poses a big problem about a small momentum of an ink drop again (that is, an ink drop has either or the both sides of the reduced amount or the reduced speed). Furthermore, if ***** of ink becomes abundant during long-term printing, since such ink will collect, nozzle failure arises by not injecting an ink drop one after another from a print head.

[0012] The foam by each generation of heat of a print head chamber results in part at least, and produces the mistaken injection to a direction and mistaken nozzle failure again. When heating ink between continuous generation of heat, the dissolution of the gas in ink advances. When the gas in ink hardly dissolves in such an elevated temperature, continuous generation of heat is ***** (ed) by the generated foam, or it is barred completely and carries out [it is clear and].

[0013] In this invention, alkyloxy polyalkylene oxy-alkanol and/or the wetting agent of a polyorganosiloxane are used

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for an ink constituent. This wetting agent not only destabilizes formation of the ink bubble at the time of generating heat the chamber in a print head which is not desirable, but functions as giving a high wettability. A wetting agent acts and this reduces the surface tension of ink so that more uniform surface energy may be formed on a nozzle plate front face. According to observation, this operation makes the minimum ***** of the ink on the front face of a nozzle plate. Furthermore, a wetting agent not only destabilizes the bubble which sets under the elevated temperature produced in the ink in an exoergic chamber, and is formed of generating of the solution gas in ink, but acts so that this bubble may be reduced.

[0014] Furthermore, if use of a penetrating agent was actually desired, it was found out by that that the amount of the penetrating agent used into a constituent can be reduced does not expect by using the wetting agent of the ink constituent of this invention. A small amount of penetrating agent may be used, and while dryness of ink is quick by such a small amount of penetrating agent in spite of it, bleeding of the neutral colors on a printing base material is prevented by the desirable thing.

[0015] In the desirable embodiment of this invention, a liquefied ink compound contains the component of the following table 1.

[0016]

[Table 1]

表 1

成分	機能	重量%
染料／顔料	着色剤	1～4
EDTA	キレート剤	0～0.1
2-ピロリドン	保湿剤／補助溶媒	4～11
テトラエチレングリコール	保湿剤／補助溶媒	8～17
1, 2-ヘキサジオール	浸透剤	3～6
ポリオルガノシロキサン	湿潤剤	0.1～10
1, 2-ベンズー		
イソチアゾリン-3-one	殺生剤	0～0.3
ほう酸ナトリウム	緩衝剤	0～0.75

[0017] This ink has ***** of about 45 dynes (dynes)/under cm² (45x10⁻⁵ N/cm²) preferably.

[0018] In a coloring agent this invention, the both sides of a pigment-content powder system and a color are included in a useful coloring agent. As known in this field, a pigment-content powder system is the mixture of a pigment and a dispersant. The pigment which can be used for operation of this invention contains all the kinds that contain organic and an inorganic pigment in the azo pigment and polycyclic formula pigment which are conventionally used in this field, basicity and an acid-dye lake, and a row of pigment.

[0019] For example, all of an acid (Acid) color and the color usually used for ink for ink jets directly (Direct) like a color, a food (Food) color, and a reactant (Reactive) color are suitable as a coloring agent of this invention. Setting in the desirable embodiment of this invention using the color combination of cyanogen / Magenta / yellow as a multicolor ink-jet system, a coloring agent is Direct as a cyano component. It is Lexmark as Blue199 and a Magenta component. It is Acid as 93A (indicated by U.S. Pat. No. 5,254,160 of registered trademarks and beaches (Beach)), and a yellow component. Yellow 23 is included. However, all the colors of the others which can form the visible image of a color on a record medium may essentially be used, and anthraquinone, Monod and a G azo stain, a phthalocyanine, and a formazan copper complex are contained in such a color. A specific color is Food, Black No.2, Direct Black 168 Acid Blue9, Acid Red 249 Reactive Black 31 Direct Black 154 Reactive Red 180 Direct Blue 86 Direct Yellow 132 is included.

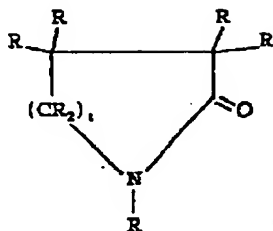
[0020] Although the amount of the coloring agent in an ink constituent may be changed according to the number of elements, usually, about 1 - 10 % of the weight of abbreviation, a coloring agent exists in the amount (based on the total weight of ink) of about 1 - 4 % of the weight of abbreviation, and includes more preferably all the ranges included by these.

[0021] The remainder of the ink constituent of an auxiliary solvent this invention is not restricted. Therefore, ink may be aqosity or non-aqosity. However, in order to assist maintaining a coloring agent in a solution and to raise an ink performance, an auxiliary solvent exists in an ink constituent. Generally, the organic agent of dissolved water in fuel like polyhydric alcohol is suitable, and ethylene glycol; propylene-glycol; butylene-glycol; diethylene-glycol; triethylene-glycol; hexylene-glycol; 1, 2 and 6, - hexane triol, and a thiodiglycol are contained in this organic agent. Poly alkyl glycol; like a diol; glycol-ester; glycerol; polyethylene glycol and low-grade alkyl ether; of polyhydric alcohol are contained in other desirable auxiliary solvents for a constituent. Furthermore, a ketone; tetrahydrofuran like [other desirable auxiliary solvents] alcoholic; acetone and lactone like ester; sulfolane; N-methyl pyrrolidone; γ-buty lactone like ether; ethyl acetate like a dioxane; an above-mentioned lactam the substitution which has the following general formula, or unsubstituted is contained in a row.

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[0022]

[Formula 4]

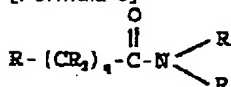


[0023] Here, R is H, C1-6 alkyl, an aryl, or a halogen, and t is the integer of 1-3. 2-pyrrolidone, a 1-methyl 2-pyrrolidone, and an N-(2-hydroxyethyl)-2-pyrrolidone are contained in desirable substitution or the desirable example of an unsubstituted lactam. Of course, you may also use a blend and mixture with some compatibility of the above-mentioned compound. It prevents that an auxiliary solvent also demonstrates the function of a moisturizer in a constituent, and ink dries it within a print head again.

[0024] The auxiliary solvent may contain the amide (1 degree, 2 degrees, and 3 degrees) with independent or mixture with what above-mentioned auxiliary solvent again. What has the following general formula is contained in a desirable amide auxiliary solvent.

[0025]

[Formula 5]



[0026] Here, R is as the above-mentioned definition and q is an integer between 0 and 6.

[0027] Usually, about 5 - 30 % of the weight of abbreviation, an auxiliary solvent exists in the amount of about 12 - 28 % of the weight of abbreviation, and includes more preferably all the ranges included here. As mentioned above, it depends for the amount of an auxiliary solvent on other components in ink in part. The compatibility mixture of the lactam (2 - 50 % of the weight, preferably 4 - 15 % of the weight) and tetraethylene glycol (8 - 17 % of the weight) like 2-pyrrolidone is contained in the desirable auxiliary solvent used by this invention.

[0028] It was found out by that acting so that the ink in which the combination of an above-mentioned auxiliary solvent and a wetting agent does not almost have the injection to the mistaken direction and nozzle failure may be offered does not expect.

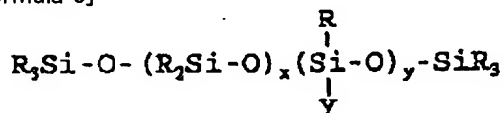
[0029] When it is desirable to use a penetrating agent (for a surfactant to be included) in a penetrating agent this invention, it is added by the ink constituent and these improve the permeability by the ink drop to a printing base-material front face, are reduced and lose bleeding (namely, bleeding of a lateral color) of neutral colors. 1 and 2 alkyl diol which contain 4-10 carbon atoms in an alkyl group which is taught in U.S. Pat. No. 5,364,461 of the beaches (Beach) by which joint transfer was carried out are contained in the desirable penetrating agent used for this invention. The most desirable things are 1 and 2-hexandiol and 1 and 2-pentandiol. In a desirable embodiment, a penetrating agent exists in an ink constituent in the amount of about 3 - 6 % of the weight of abbreviation.

[0030] Especially, the low-concentration penetrating agent could be used in the ink constituent of this invention, and the surprising thing for which reduction of bleeding of neutral colors is attained further was found out. Although it does not desire to be restrained by all specific theory, the concentration of the penetrating agent in ink is considered that an above-mentioned wetting agent reduces bleeding of a color according to an interaction with a penetrating agent at a low case more than required.

[0031] In order to reduce the injection to a direction and nozzle failure which the wetting-agent ink drop mistook, the ink of this invention also contains the wetting agent containing alkyloxy polyalkylene oxy-alkanol and/or a polyorganosiloxane. Especially the desirable kind of polyorganosiloxane is a polyorganosiloxane copolymer which has the following general formula and which was embellished with polyalkylene oxide.

[0032]

[Formula 6]

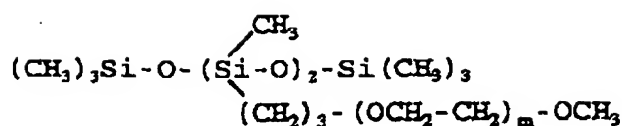


[0033] R is a methyl, Y is -(CH2)3-(OCH2-CH2)m-(OCH2-CH2-CH2)n-Z here, Z is H or OCH3, mx and y are one or more integers, and n is zero or more integers. As for the polyorganosiloxane copolymer embellished with this kind of polyalkylene oxide, the available and most desirable constituent has the following formula commercially.

[0034]

[Formula 7]

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[0035] Here, m is one or more integers.

[0036] A wetting agent exists preferably in an ink constituent in the amount of about 0.1 – 1.0 % of the weight of abbreviation about 0.1 of this constituent – 10.0 % of the weight of abbreviation, and includes all the ranges included by this.

[0037] The ink constituent of other arbitrary component this inventions may contain other desirable components which contain the chelating agent and destruction-of-life agent which are conventionally contained in the ink constituent for jet printing, a viscous improvement agent, and a buffer again. In order to avoid the detrimental effect by the contamination or impurity of a metal ion or alkali-metal ion, you may add a chelating agent like ethylenediamine tetrapod acetate (EDTA). Usually, a chelating agent is added by the constituent in the amount of about 0.1 – 1.0 % of the weight of abbreviation.

[0038] in order to prevent or suppress the microbiological growth within ink — for example, 1 and 2-bends – iso — you may add a destruction-of-life agent like thiazoline-3-one to ink. Usually, an effect will be produced if the destruction-of-life agent of about 0.1 – 0.3 % of the weight of abbreviation is added.

[0039] In order to adjust or maintain ink to desirable pH, you may also add a buffer like way acid sodium. As mentioned above, it will depend for the amount of a buffer on other components of ink. However, it was found out only by adding a small amount of buffer of about 0.25 – about 0.75 % of the weight of abbreviation in ink that effect arises.

[0040] Essentially, you may prepare the ink of the manufacture this invention of ink by all the methods for preparing the ink of the aquosity base. The desirable procedure for preparing the ink of instantiation is as follows. That is, a color, a chelating agent (EDTA), and deionization (DI) water are mixed [both], agitating for about 20 minutes. Subsequently, it adds one after another and the following component is agitated for about 15 – 20 minutes after that. The these-added component is the polyorganosiloxane embellished with lactam auxiliary solvent; tetraethylene-glycol auxiliary solvent; 1 and 2 hexandiol penetrating agent; destruction-of-life agent; way acid sodium buffer; and polyalkylene oxide. All the mixing stages are performed with ambient temperature.

[0041] All components are added, it is mixed completely, pH of ***** and ink is measured, and pH is adjusted to 7.2. Subsequently, an ink constituent is filtered and all solid contents or special material are collected.

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- 1.This document has been translated by computer. So the translation may not reflect the original precisely.
- 2.**** shows the word which can not be translated.
- 3.In the drawings, any words are not translated.

EXAMPLE

[Example] In order to understand this invention more easily, an example is shown below. These are instantiation of this invention and should not interpret it as what limits the range of this invention.

[0043] the example 1 of comparison - the example 3 of comparison -- three kinds of ink compounds which contain first the component shown in following Table 2 - 4 as an example of comparison were prepared The polyorganosiloxane embellished with 2-pyrrolidone or polyoxyalkylene is not contained in the ink of these examples of comparison at all.

[0044]

[Table 2]

表 2 (比較例 1)

成分	重量%
Direct Blue 199	2.25
EDTA	0.01
テトラエチレングリコール	20.0
1, 2-ヘキサンジオール	6.0
1, 2-ベンズ-	
イソチアゾリン-3-one	0.2
ほう酸ナトリウム	0.5
DI水	残余

[0045]

[Table 3]

表 3 (比較例 2)

成分	重量%
マゼンタ 93A	2.25
EDTA	0.01
テトラエチレングリコール	20.0
1, 2-ヘキサンジオール	6.5
1, 2-ベンズ-	
イソチアゾリン-3-one	0.2
ほう酸ナトリウム	0.5
DI水	残余

[0046]

[Table 4]

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表 4 (比較例 3)

成分	重量%
Direct Yellow 132	2.00
EDTA	0.01
テトラエチレングリコール	20.0
1, 2-ヘキサンジオール	7.0
1, 2-ベンズ-	
イソチアゾリン-3-one	0.2
ほう酸ナトリウム	0.5
DI水	残余

[0047] Four kinds of ink compounds containing the component shown in following Table 5 - 8 as an example 1 - an example 4, next an example concerning this invention were prepared.

[0048]

[Table 5]

表 5 (実施例 1)

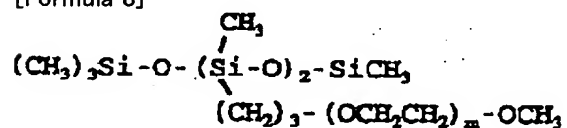
成分	重量%
Direct Blue 199	3.00
EDTA	0.01
2-ピロリドン	7.5
テトラエチレングリコール	12.5
1, 2-ヘキサンジオール	4.0
1, 2-ベンズ-	
イソチアゾリン-3-one	0.2
ほう酸ナトリウム	0.2
ポリオルガノシロキサン ¹⁾	0.5
DI水	残余

¹⁾ については別途記載する。

[0049] One in Table 5 has the following formula.

[0050]

[Formula 8]



[0051]

[Table 6]

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表 6 (実施例 2)

成分	重量%
マゼンタ 93A ²⁾	3.00
EDTA	0.01
2-ピロリドン	7.5
テトラエチレングリコール	12.5
1, 2-ヘキサンジオール	4.0
1, 2-ベンズー	
イソチアゾリン-3-one	0.2
ほう酸ナトリウム	0.2
ポリオルガノシロキサン ³⁾	0.5
DI水	残余

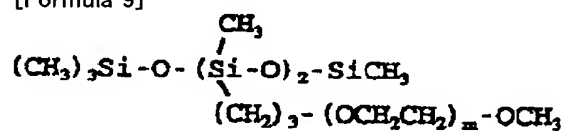
²⁾ 米国特許第 5, 254, 160 号

³⁾ については別途記載する。

[0052] Three in Table 6 has the following formula.

[0053]

[Formula 9]



[0054]

[Table 7]

表 7 (実施例 3)

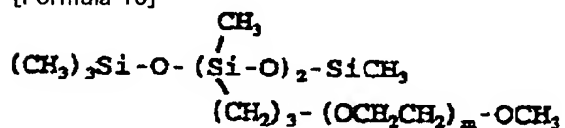
成分	重量%
Acid Yellow 23	3.25
EDTA	0.01
2-ピロリドン	7.5
テトラエチレングリコール	12.5
1, 2-ヘキサンジオール	4.0
1, 2-ベンズー	
イソチアゾリン-3-one	0.2
ほう酸ナトリウム	0.2
ポリオルガノシロキサン ⁴⁾	0.5
DI水	残余

⁴⁾ については別途記載する。

[0055] Four in Table 7 has the following formula.

[0056]

[Formula 10]



[0057]

[Table 8]

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表 8 (実施例 4)

成分	重量%
Acid Yellow 23	3.25
EDTA	0.01
2-ピロリドン	7.5
テトラエチレングリコール	12.5
1, 2-ヘキサンジオール	4.0
1, 2-ベンズ-	
イソチアゾリン-3-one	0.2
ほう酸ナトリウム	0.2
アルキルオキシポリエチレンオキシエタノール	0.5
DI水	残余

[0059] Example 5 (performance test)

The ink of this invention and the ink of the example of comparison examined the performance with 3 color ink jet printer of the high resolution equipped with the print head which has two or more nozzles. Three examinations were performed using the ink of the above-mentioned example 1 of comparison, the example 2 of comparison, and the example 3 of comparison (the comparison examination 1 - comparison examination 3), and the average of the result was calculated. Moreover, two performance tests were performed using the ink (namely, the above-mentioned example 1 - an example 3) of this invention (examination 1, examination 2), and the average of the result was also calculated. These performance tests investigated the injection to a direction and nozzle failure (that is, lock out or ink drop of a nozzle should not inject) which the ink drop mistook by observing the ink drop injected from the nozzle of a print head. A result is shown in Table 9.

[0060]

[Table 9]

表 9

インク	ノズル故障	誤った方向への噴射
比較試験 1	6	7
比較試験 2	3	2
比較試験 3	5	5
平均	4.7	4.7
試験 1	0	0
試験 2	0	0
平均	0	0

[0061] In the ink constituent of this invention, the injection to the direction which the ink drop mistook, and neither of nozzle failure were generated at all in the both sides of examination 1 and examination 2 so that it might see in Table 9. on the other hand, the injection to the direction which the ink drop mistook by the ink constituent of each example of comparison in each comparison examination and all of nozzle failure — although — it acted as several considerable shot student Moreover, when the amount of ink which flowed into the nozzle plate front face is observed, the ink of this invention is more nearly little than the ink of each example of comparison, therefore the ink of this invention can act by high frequency (that is, it can generate heat continuously more quickly).

[0062] Although an embodiment and a detail typical for the purpose explaining this invention were shown, probably, it will be clear to this contractor that the method and equipment which were indicated here can be changed variously, without deviating from the range of this invention.

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